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EXAMINER

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ART UNIT PAPER NUMBER

2122

DATE MAILED: 01/16/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

BG

Office Action Summary

Application No.
09/286,862

Applicant(s)

Prosser et al.

Examiner
Hoang-Vu Antony Nguyen-Ba

Art Unit
2122



-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Apr 6, 1999
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 9-24 is/are rejected.
- 7) ☒ Claim(s) 5-8 is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on Apr 6, 1999 is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- *See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892) 18) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 16) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948) 19) ☐ Notice of Informal Patent Application (PTO-152)
- 17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 2 20) ☐ Other:

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DETAILED ACTION

Notice to Applicant(s)

1. This action is responsive to the application filed April 06, 1999.
2. Claims 1-24 have been examined.

Information Disclosure Statement

3. The Office acknowledges receipt of the Information Disclosure Statement filed July 12, 1999. Copies of the listed applications have not been provided by Applicants but since these applications have now been issued as U.S. Patents No. 6,072,951 and 6,195,793, these patents have been considered instead.

Drawings

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because Figure 1 does not include the following reference sign(s) mentioned in the description: "operating system 132" at page 10, line 16. Correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 9-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Per claim 9, at lines 4 and 9, the term “the computer procedure” lacks proper antecedent basis. The term, “the computer procedure”, should be modified to recite “the computer program” in order to have proper antecedent basis.

Claims 10-16 are rejected because they inherit the deficiency of rejected base claim 9.

Claim Rejections - 35 USC § 101

7. 35 U.S.C. § 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

8. The invention as disclosed in claims 17-24 is directed to non-statutory subject matter. While the claims are in the technological arts, they are not limited to “a practical application of an abstract idea which produced a useful, concrete, and

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tangible result.” State Street Bank & Trust v. Signature Financial Group The rejection of claim 1 is incorporated., 149 F. 3d 1368, 1375 n. 9 (Fed. Cir. 1998).

Specifically, the claims are directed to a *program product for optimizing a computer program comprising an optimizer that saves register-pressure data and makes at least one inlining decision using the register-pressure data*. Applicants disclose that the optimizer, i.e., software component, is carried by a signal-bearing media (note that a signal-bearing media -- Applicants’ Figure 1, device 126 and specification, page 11, lines 20-26 -- is not necessarily a computer but just a storage media and interface) but fail to disclose that the optimizer is **tangibly** embodied by a computer under the State Street formulation.

On this basis, claim 17 and claims 18-24 which are dependent upon claim 17, are rejected under USC 35 U.S.C. § 101.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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10. Claims 1-4, 9-12, and 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gillies, U.S. Patent No. 5,768,595, in view of Carini, U.S. Patent No. 5,740,443.

Claim 1

Gillies discloses *a method for optimizing a computer program* (see at least Abstract, lines 1-2) *comprising a child procedure and a parent procedure, wherein the parent procedure comprises at least one statement that invokes the child procedure, wherein the method comprises:*

saving register-pressure data from the execution (see at least column 4, lines 5-33) *of a first compilation* (see at least column 3, line 54-56); *and*

making at least one decision using the register-pressure data during a second compilation (see at least column 3, lines 56-60).

Gillies does not specifically disclose *inlining*. Gillies, however, suggests that his information collection can be used for other optimization techniques, i.e., inlining and cloning (column 4, lines 24-27). Further, Carini discloses an automatic inlining method which provides the same function as user directed inlining but is more convenient in practice and requires less user effort and time (see at least column 6, lines 3-17). It would have been obvious to a person of ordinary skill in the art at the time the

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invention was made to use Carini's automatic inlining method in the second pass compilation of Gillies (Gillies, column 3, lines 56-60) because the combination of Gillies and Carini would make Gillies' recompiling of computer programs for enhanced optimization more convenient in practice and requiring less programmer's effort and time (Carini, column 6, lines 10-11).

Claim 2

Gillies further discloses *wherein the register pressure data further comprises register-pressure occurring in each procedure in the computer program* (column 4, lines 6 and 33). Gillies does not specifically disclose a *maximum* register-pressure. However, information about a maximum register-pressure is deemed to be obvious as part of information collected during the first pass compiling (column 4, line 33) in the teaching of Gillies because this information could be used to prevent code-size explosions caused by **over**-inlining, as suggested by Gillies at column 6, line 60-66. It is known in the art that it is undesirable to inline a child procedure into a parent procedure if the number of registers used reaches a maximum because to do so would spill the values stored in some of these registers into memory -- i.e., memory spill --, thereby causing more processing time delay, on top of the additional processing time caused by the code size

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increase of the program due to aggressive inlining -- over-inlining--. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use the maximum register-pressure information in Gillies to prevent over-inlining which thereby defeats the purpose of recompiling optimization.

Claim 3

Gillies further discloses *a site register-pressure comprising a register pressure at each call site in a computer program* (see at least column 4, lines 18, 24-27, and 33). Gillies does not specifically disclose call site *that is a potential inlining candidate*. However, Gillies does disclose information collected that is information usable for inlining (column 4, lines 24-25) for the purpose of optimization. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Gillies to identify call site that is potential candidate for inlining by using the information usable for inlining (see also discussion in the rejection of claim 2) because this would prevent code-size explosion caused by over-inlining which could defeat the purpose of optimization by inlining.

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Claim 4

Gillies does not specifically disclose *inlining the child procedure of the computer program into the parent procedure, in place of the statement that invokes the child procedure*. However, Carini discloses an automatic inlining method which provides the same function as user directed inlining (column 6, lines 8-10) for the purpose of performance improvements. It is noted that inlining is a well known compile-time optimization that can substantially improve the execution performance of programs by replacing a procedure -- *parent procedure* -- call with the body of the called procedure -- *child procedure* -- (also see discussion in the rejection of claims 1 and 2). It would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine Carini with Gillies because the combination would make Gillies' recompiling of computer programs for enhanced optimization more convenient in practice and requiring less programmer's effort and time (Carini, column 6, lines 10-11).

Claim 9

Gillies discloses *a computer system* (see at least Figure 5) *for compiling a computer program* (see at least Figure 5, block 38) that performs the same steps of the method recited claim 1. The same rejection is therefore applied.

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Further, Gillies discloses *a machine readable code generator that generates a machine-readable representation of the computer procedure from the optimized representation* (see at least Figure 1, block 4).

Claim 10

Gillies further discloses the same limitation of claim 2. Therefore, the same rejection is applied.

Claim 11

Gillies further discloses the same limitation of claim 3. Therefore, the same rejection is applied.

Claim 12

Gillies further discloses the same limitation of claim 4. Therefore, the same rejection is applied.

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Claim 17

Gillies discloses *a program product for optimizing a computer program* (see at least Figure 1, block 38) that performs the same steps recited in claim 1. Therefore, the same rejection is applied.

Gillies further discloses a *signal-bearing media bearing the optimizer* (see at least Figure 5, blocks 36 and 34).

Claim 18

Gillies further discloses the same limitation of claim 2. Therefore, the same rejection is applied.

Claim 19

Gillies further discloses the same limitation of claim 3. Therefore, the same rejection is applied.

Claim 20

Gillies further discloses the same limitation of claim 4. Therefore, the same rejection is applied.

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Allowable Subject Matter

11. Claims 5-8, 13-16, and 21-24 are objected to as being dependent upon a rejected base claim, but would be allowable over the prior art of record once any other outstanding rejections are traversed and if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following claimed features are not shown or suggested by the prior art of record:

determining whether a sum of the maximum register-pressure and the site register-pressure exceeds a number of available registers (claims 5, 13, and 21);

when the determining step is true, refraining from inlining the child procedure into the parent procedure (claims 6, 14, and 22);

when the determining step is false, inlining the child procedure into the parent procedure in place of the statement that invokes the child procedure (claims 7, 15, and 23);

setting the maximum register-pressure of the parent procedure to be a maximum of its existing value or the sum of the maximum register-pressure of the child procedure and the site register-pressure (claims 8, 16, and 24).

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Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Goebel reference teaches Functional Unit Switching for the Allocation of Registers, U.S. Patent No. 5,987,259.

b. Sato reference teaches Program Complete System and Its Compile Method for Efficiently Compiling a Source Program Including an Indirect Call for a Procedure, U.S. Patent No. 6,292,940.

c. Hanson et al. reference teaches Method and Apparatus for Profiling Indirect Procedures Calls in a Computer Program, U.S. Patent No. 6,026,234.

d. Hicks et al. reference teaches Method and Computer Program Product for Implementing Method Calls in a Computer System, U.S. Patent No. 6,175,956.

e. Schmidt et al. reference teaches Compiling with Partial Copy Propagation, U.S. Patent No. 5,937,196.

f. Aizikowitz et al. reference teaches Cooperation of Global and Local Register Allocators for Better Handling of Procedures, U.S. Patent No. 5,890,000.

g. Koblenz et al. reference teaches Register Allocation Methods Having Upward Pass for Determining and Propagating Variable Usage Information and

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Downward Pass for Binding; Both Passes Utilizing Interference Graphs Via Coloring,
U.S. Patent No. 5,530,866.

h. Aizikowitz et al. reference teaches Register Allocation Method and
Apparatus for Generating Spill Code as a Function of Register Pressure Compared to
Dual Thresholds, U.S. Patent No. 5,946,491.

i. Roediger et al. reference teaches Lifetime-sensitive Instruction
Scheduling Mechanism and Method, U.S. Patent No. 6,305,014.

j. Bates et al. reference teaches System for Partial In-line Expansion of
Procedure Calls During Program Compilation, U.S. Patent No. 5,701,489.

k. Schmidt reference teaches Method and Computer Program Product for
Adaptive Inlining in a Computer System, U.S. Patent No. 6,195,793.

l. Donovan et al. reference teaches Profile Driven Optimization of
Frequently Executed Paths with Inlining of Code Fragment (One or More Lines of
Code from a Child Procedure to a Parent Procedure), U.S. Patent No. 6,072,951.

m. Goebel reference teaches Method and Apparatus for Easy Insertion of
Assembler Code for Optimization, U.S. Patent No. 5,815,719.

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13. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Examiner Antony Nguyen-Ba, whose telephone number is (703) 305-0103. The Examiner can normally be reached on Monday-Thursday from 6:45 AM - 4:45 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory Morse can be reached at (703) 308-4789.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

A handwritten signature in black ink, reading "Hoang-Vu Antony Nguyen-Ba". The signature is written in a cursive, flowing style with a long horizontal line extending to the right.

Hoang-Vu Antony Nguyen-Ba

January 2, 2001